METHOD AND APPARATUS FOR IDENTIFYING FEATURES OF MULTIDIMENSIONAL IMAGE DATA IN HYPERMEDIA SYSTEMS

Field of the Invention

The present invention relates to a method and apparatus for
identifying features of multidimensional image data in hypermedia
15 systems.

Background Information

The World Wide Web ("Web" or "Internet") provides a simple
20 mechanism, called an image map or ISMAP, for linking two-
dimensional spatial data (e.g., images) to related symbolic
information such as Universal Resource Locators (URLs). Image
maps are a simple technology that link simple polygonal regions
within images, often referred to as hotspots (e.g., a graphically
25 defined area in an image), to the locations of data objects on
the Internet via a hyperlink. Web image maps currently are the
standard mechanism used for creating graphically attractive user
interfaces to Web pages. For example, an image could be made
into an image map by assigning hotspots to each region of
30 interest on the image. Unfortunately, the standard polygon-based
ISMAP technology used in most Web image map systems can only work
with simple polygon maps, and becomes either intolerably slow or

totally unusable for mapping high-resolution images with large numbers of irregularly shaped objects, such as, for example, objects in the medical anatomy image data which comprise the National Library of Medicine's Visible Human Project.

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U.S. Patent No. 4,847,604, which is hereby expressly incorporated by reference, describes a method and apparatus to provide additional information concerning a feature of a displayed image by pointing to the location of the feature. The '604 patent

10 provides for the correlation of particular locations in the image with the additional information for two-dimensional images. A need exists to provide such correlation for multidimensional images.

15 Summary of the Invention

A multi-dimensional object indexing system allows many discrete objects to be mapped within a single multi-dimensional dataset. A secondary spatial image of an original image is correlated using a multi-dimensional coordinate value to provide an object

20 index for each object defined in the original multi-dimensional image.

Brief Description of the Drawings

25 Figure 1 illustrates a flowchart for a method of identifying features of multidimensional image data according to an exemplary embodiment of the present invention.

Figure 2 illustrates a flowchart for a method of processing multi-dimensional image data according to an exemplary embodiment

30 of the present invention.

Figure 3 illustrates an exemplary system for identifying features of multi-dimensional image data according to an exemplary embodiment of the present invention.

Figure 4 illustrates an exemplary database table according to an
5   exemplary embodiment of the present invention.

Detailed Description of the Invention

Figure 1 illustrates an exemplary flowchart for a method of identifying features of multidimensional image data according to
10 an exemplary embodiment of the present invention. For example, at 1010 an image is accessed, such as a multi-dimensional image or animated GIF image on a web page. At 1020, a location in the image is indicated, for example by clicking on a part of the image using a mouse or other interface device, the image having
15 been preprocessed to be an image map as described, for example, in the '604 Patent or as described below with regard to Figure 2.

At 1030, a multidimensional coordinate location is determined for the location identified at 1020. For example, the image map may
20 be a two-dimensional representation (e.g., x-y) of a three dimensional image, such as a three dimensional medical anatomy image maintained by the National Library of Medicine's Visible Human Project. The two-dimensional representation may reflect a particular third dimension view. For example, a particular slice
25 of the image may be shown to a user thus providing a predetermined third dimension, or z-value, for the representation of the image displayed to the user. Accordingly, selecting a particular location on the representation defines the x and y values for the location and the third dimension is already
30 defined. As a result, the multi-dimensional coordinates of the selected image location can be determined.

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In an alternative exemplary embodiment of the present invention, the selection of a image for correlation with additional information may be a multi-step process. For example, an image of an entire anatomical body could be presented to a user and a

5   general area of the image selected, such as the chest, head or abdomen. In response, a detailed view of the related region could be displayed to the user. The user would then select a particular location in the image and receive additional information related to the selected location. As noted above,

10   the images presented to the user will generally be two-dimensional representations viewed on a predetermined or selectable third dimension. In addition, the original image can be manipulated, rotated or sliced for viewing in a preferred orientation. The image location eventually selected by a user,

15   regardless of the orientation and display of the image, will correspond to a particular multi-dimensional coordinate which can be correlated with additional information as described below.

Alternatively, the image map could be a video clip having x and y values for each frame of the video clip and the third dimension,

20   in this case time, would be determined by the particular frame of the video clip. Thus, multi-dimensional values can be determined for an indicated location. The present invention is not limited, however, to three dimensions as four or more dimensions can be processed according to exemplary embodiments of the present

25   invention. For example, a three dimensional image dataset that changes through time would provide for four dimensions (e.g., x, y, z and time).

At 1040 a secondary map is queried for the determined multi-

30   dimensional value where, for example, a given x,y,z coordinate in the original image data corresponds to an homologous x,y,z location in the secondary "map" of, for example, 24-bit voxels

(e.g., three-dimensional pixels). The 24-bit voxel found at that
location in the secondary map then acts as a unique 24-bit object
index for the image feature in the original data. At 1050, the
system then performs a database table lookup for that 24-bit

5   index in order to find the related descriptive text information
or "hot data," which may be in the form of, for example, HTML
code, a URL pointer to a remote Web resource, or Tcl-based applet
code. Using the 24-bit voxel allows as many as 16 million
discrete objects to be mapped within a single three-dimensional

10   dataset. If desired, even more objects could be mapped in the
dataset by using 32-bit voxels. Using an exemplary embodiment of
the present invention, animated GIFs, AVIs and MPEGs can be
processed to provide enhanced functionality to a Web page to
extend image capabilities to multi-dimensional datasets.

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Figure 2 illustrates an exemplary flowchart for a method of
processing image data according to an exemplary embodiment of the
present invention. At 2010, multi-dimensional image data is
imported. The image data can be, for example, a GIF file of an

20   image or a JPEG or MPEG file of images. At 2020, objects in the
image data (e.g., hotspots) are, for example, interactively
outlined. An exemplary method for outlining the objects is
described in the '604 Patent although other conventional
approaches known in the art may be used. The outlining of

25   hotspots requires the user be presented, for example, a two
dimensional representation of a multi-dimensional image as
described above. Thus, additional dimensions can be predefined
for the two-dimensional views presented to a user. At 2030, a
program action is determined and associated for each object in

30   the image data. For example, the program action can display
explanatory text related to the object in the image or provide a
link to a particular Web page. As described above, the program

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action can be in the form of, for example, HTML code, a URL
pointer to a remote Web resource, or Tcl-based applet code.

At 2040, a secondary image map is generated for the image data.
5   The secondary image map provides, for example, a spatial index of
the image with equivalent spatial dimensions as the original
image. The secondary image map utilizes, for example, unique 24-
bit voxels to associate a unique 24-bit identifier with the
pixels in an object outlined at 2020. Alternatively, pixels
10 within an object can have different unique identifiers defining,
for example, sub-regions in the object having associated program
actions. Other object indices could be used instead of the 24-
bit voxels, however, such as a list of polygons or some other
indice that correlates a coordinate value in the original image
15 with the secondary image map. The 24-bit values are, for
example, arbitrarily assigned to groups of pixels or individual
pixels in the object.

According to an exemplary embodiment of the present invention,
20 each pixel in the object can be an independently addressable
hotspot, including for multi-dimensional images. For example,
for each mapped multi-dimensional image on a Web page, the Web
server hosting the Web page stores the secondary image map. Each
pixel or group of pixels in a hotspot defined for the image
25 corresponds to, for example, a flat area of 24-bit color in the
secondary image map, as each object pixel or group of pixels owns
a unique 24 bit color in the secondary image map. While the
primary (original) image is displayed to the user, the secondary
image may is generally not shown to the user, although there may
30 be circumstances in which it is desirable to show the secondary
image map. At 2050, object table files are generated to
associate the pixels in each object with the program action
identified at 2030. The object table can have the form of, for

example, a database lookup table indexed by the 24-bit voxels to find the corresponding program action for each pixel.

Exemplary operation of the method for identifying features in multidimensional image data is as follows and as illustrated in
5 Figure 3. When a user clicks on a location of a multi-dimensional image in an image map in a Web page via a Web browser, the Web browser sends the, for example, x-y coordinates of that location to the Web server. Web browser 3015 can include, for example, conventional Internet browser software such
10 as NETSCAPE® browser software operating in a conventional desktop personal computer 3010, as illustrated in Figure 3. Web browser 3015 transmits the x-y coordinates to Web server 3020 via a communications link 3030, such as a LAN, WAN, fiber optic, wireless or other conventional computer network communications
15 link. Web server 3020 includes, for example, a conventional NT or SUN Microsystems server and processes the x-y coordinates to generate a multi-dimensional coordinate value.

As described above, the third dimension may be predetermined as a
20 function of the image presented to the user such as a particular "slice" of an image or a frame of a video clip. Once the multi-dimensional coordinate value is determined, the Web server 3020 launches a, for example, Java-based CGI program to find the corresponding multi-dimensional coordinate value in the secondary
25 image map to determine the unique 24 bit value corresponding to the pixel clicked on in the image by the user. The CGI program then sends the 24-bit value to a, for example, Tcl-based server which takes the 24-bit value and fetches a record from the database lookup table for the corresponding program action to be
30 taken, or the Web server 3020 itself processes the 24-bit value and uses the value as an index into database 3040 coupled to Web server 3020 to determine the program action to be performed. The

program action is relayed back by the Web server 3020 for display
to the user at client computer 3010, usually in a frame next to
the image map. The program action can include, for example,
browser redirection, encapsulated HTML, dynamic HTML and
5   downloading and running full-frame applets in the user's Web
page. Other program actions can be performed as well. Figure 4
illustrates an exemplary database table associating a program
action 4020 with each identifier 4010 in the database table, such
as each unique 24-bit value.

10
Thus, according to an embodiment of the present invention,
individual pixels or voxels in objects of multi-dimensional image
data can be automatically linked to desired program actions in
contrast to prior art systems which are limited to indexing of
15   two-dimensional Web images.

The additional dimension added to the indexing of image maps can
vary as a function of the type of image data displayed. Thus,
for example, the additional dimension could be the z-coordinate
20   for three-dimensional images or the time dimension for video
clips or both for three-dimensional image data recorded over time
as well as additional dimensions. Like the multi-dimensional
image data, the secondary image map according to an exemplary
embodiment of the present invention can have n-dimensions. In
25   addition, the individual pixels in an object of a multi-
dimensional image can be individually addressable. Moreover, by
adding a dimension to a standard image map request protocol in
accordance with an exemplary embodiment of the present invention,
the display of an image on a client side of computer network can
30   be independent of the server performing the object identification
in the image, thus allowing the capabilities provided by the
present invention to be implemented using conventional personal

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computers or even less powerful devices such as handheld
computers or smartphones.

An exemplary implementation of the method according to an
5   embodiment of the present invention is illustrated below and uses
a small (30K) Tcl-based client applet which downloads and runs
within the user's Web browser page. For example, when a user
accesses a web page with multidimensional image data to be
viewed, an applet such as the applet described below would be
10   automatically downloaded to the client computer. The applet
would then, for example, fetch the appropriate image data,
secondary image map and object index table and download the data
to the client computer. The client computer web browser then
interacts with the download applet to view the image data, for
15   example in the manner described above. For example, the Tcl
applet converts the image data back to a viewable image. If the
image is a video clip, for example, then the video clip would be
displayed to the user. The applet program then waits for the
user to click on a location in the video clip. When the user
20   clicks a location, the frame number is determined and the x-y
location of the click is determined as described previously,
thereby enabling a multidimensional coordinate location for the
click to be determined to use as an index into the secondary
image map, from which the program action can be determined via an
25   object index table.

**Tcl/Tk (v. 8.0) Source code for a zMap client-side applet (requires the Tcl Netscape
plug-in v. 2.0 from Sun Microsystems, or equivalent):**

```
       #   Eolas Client-side zMap Applet
       #   Copyright (C) 1997, 1998 Eolas Technologies Incorporated.All rights reserved
30     #   Distributed only as a part of the Eolas zMap CS v 1.0 package
       #   For more information on Eolas' zMap products, see http://zmap.eolas.com

       policy outside
       package require http
#################################################
35     #   zMap procedures
       #
```

```tcl
###################
proc zmap_setup {} {
        global strip which nFrames delayInterval oldurl zmap_url _url width map \
        clr_map zmap rgb target
        set which 0

        image create photo strip -data $strip
        image create photo clr_map -data $map
        label  zwin.1 -border 0; pack zwin.1
        pack .zwin -anchor w -expand 0 -fill none
        set nFrames [expr [image width strip] / $width]

        for {set i 0} {$i < $nFrames} {incr i} {
            image create photo p$i
            p$i copy strip -from [expr $i * $width] 0 [expr ($i + 1) *$width] 50
        }
        set which 0
3 set up binding for imagemap query as a result of user's mouse click
                bind zwin.1 <Button-1> {

                        set zmap_x [expr ($which * $width) + %x]
                        set zmap_rgb [clr_map get $zmap_x %y]
                        set rgb_list [split $zmap_rgb]
                        ::browser::displayURL [querytcl [lindex $rgb list 0]\
                                [lindex $rgb_list 1] [lindex $rgb_list 2]] $target
                }
                bind zwin.1 <Button-3> {
                        ::browser::displayURL http://www.eolas.com/metamap $target
                }
}

###################
proc zmap_playnext {} {
        global  nFrames which delayInterval

            if {$delayInterval != 4000}  {
              incr which
              if {$which >= $nFrames}  {set which 0}
              .zwin.1 configure -image p$which
            }
            after $delayInterval zmap_playnext

}

###################
proc querytcl {R G B}  {

global header ztable

set id [array startsearch ztable]

if {[string length $R] == 2} {
        set R 0$R
        } elseif {[string length $R] == 1}
        set R 00$R
        }

If {[string length $G] == 2}  {
        set G 0$G
        } elseif { [string length $G] == 1}  {
        set G 00$G
        }

if {[string length $B] == 2}  {
        set B 0$B
        } elseif { [string length $B1 ==1}  {
```
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```tcl
            set B 00$b
            }

    set searchfor $R$G$B

            while {[array anymore ztable $id] != 0} {
                set colors [array nextelement ztable $id]

                if {$colors == $searchfor} {
                  set record [array get ztable $colors]
                  set record [lindex $record 1]
                  set flag [lindex $record 2]
                  set script [lindex $record 3]

                  switch [string trim $flag] {
                    html { return "$header(html)$script" }
                        url { return "$script" }
                        default { return "$header(html)Incorrect flag in \ database" }
                  }
                  array donesearch ztable $id
                  break
                }
            }
    }
    ###################
    proc assign_strip_url {token} {

    global url_data state strip go

            upvar #0 $token state
            set url_data $state(body)
            set strip $url-data

    if {$go < 3} {
            incr go
            } else {
            zmap_setup
            zmap playnext
            }
    }

    proc assign_map_url {token} {

    global url_data state map go

            upvar #0 $token state
            set url_data $state(body)
            set map $url_data

    if {$go < 3} {
            incr go
            } else {
            zmap setup
            zmap_playnext
            }
    }

    proc assign_table_url {token} {

    global url_data state table go ztable

            upvar #0 $token state
            set url_data $state(body)
            set table $url data
```

```
        array set ztable $table

    if {$go < 3} {
            incr go
    } else {
5           zmap_setup
            zmap_playnext
            }
    }

    # end proc definitions

10  ####################
    # begin code main body
    ######.##
    global ztable width delayInterval header map clr_map zmap_rgb url_data strip \
    state table go target
15  set width $embed_args(frame_width)
    set map_image $embed_args(map_image)
    set anim_image $embed_args(anim-image)
    set dfile $embed_args(dfile)
    set target $embed_args(target)
20  set rate $embed-args(rate)
    set delayInterval $rate
    set header(htm-1) "Content-type: text/html\n\n"
    set header(url) "Location: "
    # Fetch the image, map and object-table data
25          ::http::geturl $anim_image -command assign - strip_url
            ::http::geturl $map_image  -command assign_map_url
            ::http::geturl $dfile      -command assign_table_url

    set Name.zwin
    frame $Name   -background LightGray -border 0 -relief flat

30  scale zwin.scale -from 1 -to 4000 -orient horizontal -width 8 -sliderlength 8 \
        -tickinterval 0 -length $width -variable delayInterval -showvalue 0 -borderwidth 0
    \
        -troughcolor black -border 0
    pack.zwin.scale -side bottom

35  set go 1

    ######
    end of applet source code
    ####################

40
```

An exemplary object index, image and secondary image map are
illustrated below.

Object information table for the above zMap client-side applet demo:
(filename: world.mtb)

189129190 {south_america_too {{}} url south_america.htm} 251000251
{carribean_islands {{}} url caribbean.htm} 185255185 {ireland {{}} url
ireland.htm} 255196255 {australia {{}} url australia.htm} 078173214 {cook_island
{{}} url pacific_rim.htm} 155155155 {south_america {{}} url south_america.htm}
255255081 {indian_ocean {{}} url indian_ocean.htm} 000189000 {africa {{}} url
africa.htm} 102102255 {japan {{}} url japan.htm} 000128000 {hawaii {{}} url
hawaii.htm} 255198140 {europe {{}} url europe.htm} 255183219 {bermuda {{}} url
bermuda.htm} 189185219 {iceland {{}} url iceland.htm} 255000000 {atlantic_ocean
{{}} url atlantic.htm} 255196225 {australia {{}} url australia.htm} 255185220
{asia {{}} url asia.htm} 128000128 {indonesia {{}} url indonesia.htm} 255128000
{pacific_ocean {{}} url pacific_rim.htm} 230204255 {new_guinea {{}} url
newguinea.htm} 255077166 {arctic_ocean {{}} url arctic.htm} 189189255
{mediterranean_sea {{}} url mediterranean.htm} 064128128 {north_america {{}} url
north_america.htm} 000255255 {bering_sea {{}} url pacific_rim.htm} 255255000
{new_zealand {{}} url newzealand.htm} 64128128 {north_america {{}} url
north_america.htm} 064149200 {greenland {{}} url greenland.htm} 255255255 {space
{{}} url space.htm} 000185000 {madagascar {{}} url africa.htm} 148148148
{indonesian_islands {{}} url indonesian_isles.htm}

Animation image strip for the zMap applet demo (Base64-encoded GIF image):
(filename: world.man)

RO1GODdh3AUyAKUAAAAAAAAAbQAAmAAA7gAAhAAAxgAAsgAAigAAtQAASwAAoQAAzAAA9wDv
AAAA+gDXAAAA5gAAfADNAADHAADBAAAA/QC5AACvAAClAACZAACLAAAAwQAFIgAA7AB7AAAA
rQAA2ABTAAAA1AAAA8gAAiAAA3gAAtgAAkQAAEwAAvwAA1gAA1wD8AAD2AAAAbwDoAADgAAAA
yAAA8wAAYQAA4gAAeAAAowBoAAAApgAAPAAA0QAA/AAAUwAAA6AAA6AAAAACwAAAAA3AUyAAAG
/kCAcEgsG1HIJMxIbDqfRCV0Sn0mq9isEKntaq/e8HbIFZu31+W5Ky2vvWr1Gx6f08H2Lz5f
Vbr5UH5ygIF+hFSCh10JilaGjU51g5BHS3+UlZ0YRZebnGOeTXuhAFKkUaanjKqPrKmhgpqN
KCIcOTkJubkivCKQSBy2uLohvMGydkvBt7oJxTkcvrMowSLDuSE5tSLIc8DCzQm3wb/U4M3j
OorfzOjQHL8AvSLh4/CU8/Xv5b3XuemUqFmj544cpWoEddnr5q2aP3H7Dp5TCE3dIXYPAUps
RzFawGUZK2ICWa9XOZLueH2c+E/kL5QdLV6E2bLWSJYQDUKimZMD/sM5PK3pbMTTHiZeHFse
w4dz4caHve7Nolms108zvBLwmME1gFevM26E4CFOah5rWrnO+AqWK49sMueg3dqVrVqyKgHN
Vcs2ANcQgLUR21v3690EefNQwOV3rV23iOOuWaw1ROG2M/BKXmMr7WW/kBMn69y472HRdngB
5vs4c1lAtEQAtuzYcGizdmzNvlEbs2bYnQHzNu22KqFonnuDdo0aKC7hyu8aB4T87fDWgJu/
UV0a+3Q+hKOH3nwmPPHM350Zb/2bD+XutpmTx8qYtWHeZAXrrf/59Hwx68WXOH25y0QOfb+L8
FOaAXt0g1oCDGWhfg2IFRuB2En7m4Gw2/uk124EBbJjdhWtwN2GIDyYInmw3hOhCDTBGICOM
NbgAVjYkeqGagwG8GOOMMNrIG46picBDiz3SKGMENAopVocYbuWVjzUs2eSN2sHBi5RJ/shk
kFgqiMWWj1FpJZghpmfGYlyaCWSNDaopBptlKvmmjX7xAOUZtOTA5Q12fgmnX3A15GeZHnh5
JaF7rrnj1IEu+mSOXOQTgoM3uCkonpOm1sOlmEbqgQctbpg1G9FshemoVd6JqZwAGrmWg6ye
WeOrp3axJZI3jOqBrU7CuuCndY4KbJy5aqHarLOmCmypwrKx65S+/spkonjOEK2usqII46+/
fpvttlkIZBmk/j+yOqi2yWKx2L1dtqruuO32QSa6rUbAarZ6Uqpst/HKWC2SmekXZZ3p1jAq
jwX7m8Wy+C7pK6Y38ABNkZdGLPDCr15cILyaKuzBuB5jmHHAQI4M1sUOj8mixl+SiiKRJbLY
bAQEEEACCQf0vDMBvrrgoJ5iPrHjzTnv3PMBPxNw7YY1h2Eprb7qzLPPJOT89JNFO3F0tRoo
jbXWCpvadROPuvBrO1oznbXTZXO95tRJ4qyzBks3vTW5U6RdpQdW4+022ULSHAabDr5ot9J4
6x03y3MfWjfbPYf99taQz6nbWopTPrbTHBsOhy1Sdm513iRoAHTcxbT8RKphmS62/tsaDCyW
wcMe2WuVng9ue+v1SV5t4J9PLLcZurWo9qiWH9B46nCTenysqr7IfNiV/wyu9HxD8aizHmgg
/tJhE262oy93Lv74g8Mt9PRa2qy2vgSs/zzhadYbydRIh22/49zTnyiONj/A2U9817sV/FA1
v78F7oDuy9/ZjkC62PGufgoUX7hspC3cSctIyrtg6jK4rzxF7YMZkx3P7AcOX4Uoc7EC1Qqz
pzrQkapgEzQCAUXYtp2pjknvg+GCbOas3ultVIQ6IbdAVcTT+Ux8qxOSEHVERB6ijmw3nKKy
mMg8561gBQIIYxi/eALnTSwzORwCEa93gi+KcYwrKCMJ/sBlKgBxMXzic+MbyWjGORVRCGvE
owYyAEYBZACOZaydH+1INQwOspBi5OMcF7mgO+JtkBk4ZCTjyDS4DSOHANKdwnTmxUzukZOK
rIEJD/epFo3qbm0EYyYP+cX1ubBgrJSSr3h2AkKGcZaZPIEGF4ZLOEiOd7zU4y8zaUuOWSyX
aOHmAWJpSDEyc5jSe6YxpSRNau4xA83MJijD4KcWdVOZcAxnHRekql10E52GXIE6nyQGYqVA
ZOLz5iYTabxihHItalufLO8px37+UR7nEtkKZ01QphmUkb3CGd56yVBEQpGSOrKkBmIJTAHw
sXb6WicbWtksD6zQjcCUpAvp/rnNRk5UjymVI+hE+gWS7nKjAl0mODvJJJqWq5w1PaksrQnO
8jEpT39EgfBGlcxCmrKWUNQXUg8HwojW751DRaQZj1pML9gUcE19o0d3mjUkdlVXdwzrKW3Z
07NukWomxeobCZmBRLZwlZWE60shOcaigrQG+BmnjjSqz3T20QOMyquvxDdLDNgAB5CFLAYw

MEtssvSti8VkBiYbWQzgwAaUvebE/InWkjI2k5P1bGRtoIDKKpJUpMXs9RqbWs6yVgEetWxs
H3apzNK2tqmdZR1HZSNtyhaPvwVuaHcKugAY17emlaxygyvaCBRXsFn4VAB8KwAFTHeyrgXa
dUd6/iRw5bG73p2ua3813pryoEf60q0CvIsDz9Z2vSOrGHb74Cf4EmCas1TAYyVL3aK68Ln8
fa8LcPb07jo2spAFLX5hu98q9HfB9Wsjege82uXqNo0XZrCG58vhCLdWtAvb72gutWA8gpHE
EP7sfFEM2xzSorwMlqyAY4yBGRs4xWmUDXw98E7UqnalJ/5xjQcbUSIP0sGpRfKEL+suFmV2
BRmYL3BljFs1U5m/vZ1tlh9c29t6VJgt/DIi+uvbMR+5trjlJHHVvAg2M6+XUOZsfcGb2wPM
VMVrLq+YNwvaKLM2k3H8YXFtfOFBp5fAPe5yGZ22aPL6V74C5qx9KZtb/kU7t8JU004rcZrJ
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Secondary-map image data for the zMap demo applet (Base64-encoded GIF image):
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cLAICAAAOw==

An alternative exemplary implementation according to an embodiment of the present invention could use a small (30K) Tcl-based client applet similar to that described above which downloads and runs within the user's Web browser page but where

5   the image data is not downloaded to the client computer but instead is remotely manipulated by the user. For example, the image data could be too large to download to the user. Such an applet would, for example, open a socket communications channel to a remote visualization server that stores and manipulates

10   three dimensional image data. When the user makes a change to the controls in the applet GUI, such as to specify rotation around an axis, the remote visualization server would perform that computation on the data and transfers the resultant data display back to the user for viewing the result of the

15   manipulation within the display frame of the client applet. The user could, for example, slice through the data at any angle and click upon any voxel on any slice surface to cause the associated descriptive text to be shown in the lower widow of the applet, for example in the manner described above. The efficiency of

20   this type of system is such that object identification and response occurs in nearly "real time" with identification speeds of, for example, approximately ½ second over 56KB Internet connections.